
स्वचल वाहनों की परिचालन ज्यामिति के
मानदंडों की परिशुद्धता आकलन पद्धति
(दूसरा पुनरीक्षण)

**Method of Evaluation of Accuracy of
Parameters of Steering Geometry of
Automotive Vehicles**
(*Second Revision*)

1CS 43.040.50

© BIS 2018



भारतीय मानक ब्यूरो
BUREAU OF INDIAN STANDARDS
मानक भवन, 9 बहादुरशाह ज़फर मार्ग, नई दिल्ली-110002
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
NEW DELHI-110002
www.bis.gov.in www.standardsbis.in

FOREWORD

This Indian Standard (Second Revision) was adopted by the Bureau of Indian Standards, after the draft finalized by the Automotive Braking and Steering System, Vehicle Testing and Performance Evaluation Sectional Committee had been approved by the Transport Engineering Division Council.

The overall performance of an automotive vehicle is a function of performance of its various components, systems, instrumentation, etc. The steering geometry is an important parameter for the evaluation of performance of the steering system of an automotive vehicle. For steering effort, reference may be made to IS 11948 : 1999 'Automotive vehicles — Steering effort — Method of evaluation'.

This standard was first published in 1987 and first revised in 2007. The current revision is the second revision and has been undertaken the standard with latest developments in the field. In this revision, following changes have been incorporated:

- a) Definition of caster offset is given in detail with supporting figure (with reference to SAE Handbook Vol III; Page 34.411) for enhanced clarity.
- b) Definition of kingpin inclination is given in detail with supporting figure (with reference to SAE Handbook Vol III; Page 34.411) for understanding.
- c) Note on input turn of steering wheel available at wheel lock angle, has been revised and added for manual steering system and power steering system respectively. Cautionary note has also been added for checking input turn of steering wheel available at wheel lock angle.
- d) Note on priority of wheel alignment for vehicle with rear axle steering has been included.

For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated expressing the result of a test or analysis, shall be rounded off in accordance with IS 2 : 1960 'Rules for rounding off numerical values (*revised*)'. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

Indian Standard

METHOD OF EVALUATION OF ACCURACY OF PARAMETERS OF STEERING GEOMETRY OF AUTOMOTIVE VEHICLES

(Second Revision)

1 SCOPE

This standard gives the method of evaluation of accuracy of parameters of steering geometry of automotive vehicles like cars, buses, jeeps and trucks.

2 REFERENCE

The following standard contains provision which, through reference in this text constitutes provision of this standard. At the time of publication, the edition indicated was valid. All standards are subject to revision and a party to agreements based on this standard is encouraged to investigate the possibility of applying the most recent edition of the standard indicated below.

IS No.	Title
9435 : 2004	Terms and definitions relating to dimensions of road vehicles other than 2 and 3 wheelers (<i>first revision</i>)

3 TERMINOLOGY

3.1 Unless otherwise stated, the definitions of terms used shall be according to IS 9435.

3.2 Caster Angle — Caster angle is the acute angle between the vertical line passing through the centre line of the steered wheel and the real or imaginary swiveling axis of the stub axle in the longitudinal plane (*see Fig. 1*).

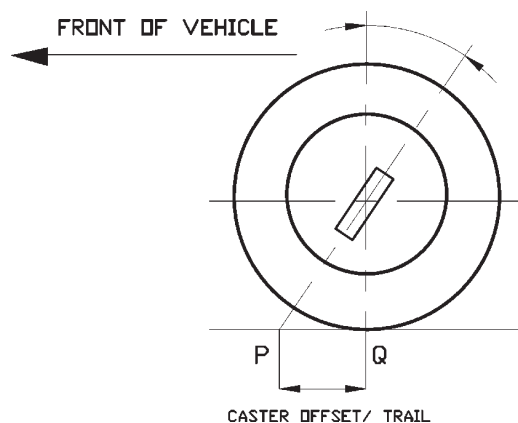


FIG. 1 CASTER ANGLE AND CASTER OFFSET

The distance in side elevation between the points where the steering axis intersects the ground (Point *P*) and centre of tire contact (Point *Q*) in straight ahead position of the steered wheel is defined as caster offset/trail. This offset is considered as positive when Point *P* is ahead of Point *Q* seen in the direction of forward travel of the vehicle, and negative, when it is *vice-versa*.

3.3 Wheel Lock Angle — Wheel lock angle is the acute angle in the horizontal plane between two centre lines of the steered wheel projected on to the horizontal plane when the wheel is in the straight ahead position and when the wheel is steered to its extreme position. The term inner wheel lock angle shall mean the wheel lock angle for the left turn and right wheel, when steered for a right turn. Similarly, outer wheel lock angle shall mean wheel lock angle for left wheel, when steered for a right turn and right wheel, when steered for a left turn.

3.4 Camber Angle and Kingpin Inclination (*see Fig. 2*) — The acute angle formed by a vertical line and the midplane of the wheel. The angle is positive when the wheel leans out at the top is defined as camber angle (*C* in Fig. 2). The angle in front elevation between the steering axis and the vertical is called kingpin inclination (KPI in Fig. 2)

NOTE — Camber angle is measured in the unladen condition of the vehicle.

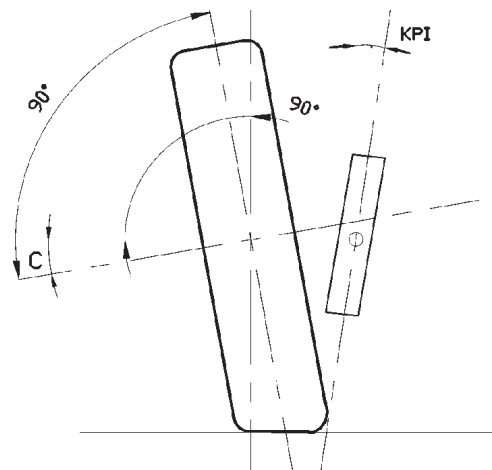


FIG. 2 CAMBER ANGLE AND KINGPIN INCLINATION

3.5 Toe-in (see 3.5.1 and 3.5.2)

3.5.1 Toe-in Length — The ends of the horizontal diameters of the interior contours of the rims corresponding to the same axle are the apices of an isosceles trapezium. The difference between the length of the rear base and that of the forward base of the trapezium is the toe-in, the difference being positive when the wheels are closer together in front than behind, and negative in the contrary case (see Fig. 3).

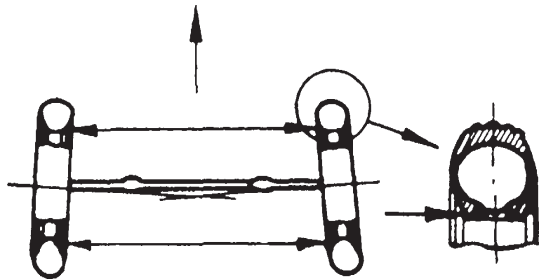


FIG. 3 TOE-IN LENGTH

3.5.2 Toe-in Angle — The angle formed by the horizontal diameter of the wheel and the longitudinal median plane (of the vehicle) or the acute angle formed by the vertical plane G passing through the axis of the axle-pin and a vertical plane H perpendicular to the longitudinal median plane (of the vehicle) (see Fig. 4).

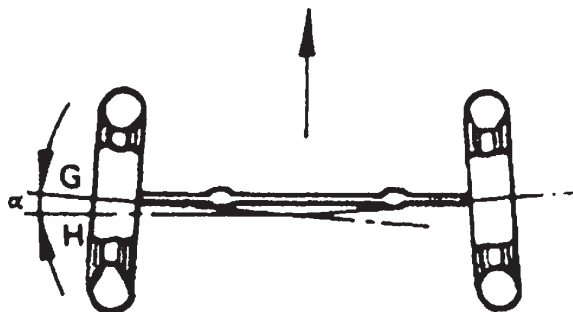


FIG. 4 TOE-IN ANGLE

3.6 Turning Circle Radius — Shall be the half of the value of turning circle diameter (outer) as defined in 3.1 of IS 12222.

3.7 Turning Clearance Circle Diameter — Shall be the diameter of the circle defined in 4.32 (b) of IS 9435.

4 PREPARATION OF VEHICLE

4.1 The vehicle shall conform in all its parts and components to the design and/or production series as applicable.

4.2 The tyres shall be inflated to the pressure recommended by the vehicle manufacturer.

4.3 Unless otherwise mentioned, the vehicle shall be loaded to the rated gross vehicle weight (GVW), with the load distribution between the axles being that recommended by the manufacturer corresponding to the rated loads.

4.4 The vehicle shall be stationary and all the wheels shall be resting on a level horizontal surface.

5 ESSENTIAL PARAMETERS OF STEERING GEOMETRY OF AUTOMOTIVE VEHICLE

5.1 While checking the following parameters, the accuracy of measurement shall be as indicated below unless otherwise agreed to between the manufacturer and the purchaser.

Parameter (1)	Accuracy of Measurement (2)
Caster Angle	15'
Wheel Lock Angle	60'
Camber angle (to be measured in a condition of loading as recommended by the manufacturer)	
Kingpin Inclination	15'
a) Toe-in	As per manufacturer's recommendation in mm
b) Toe-out	As per manufacturer's recommendation in mm
c) Turning Radius	As per manufacturer's recommendation in mm
d) Turning clearance circle diameter	As per manufacturer's recommendation in mm

5.1.1 The ranges of various parameters shall be as specified by the manufacturer.

5.2 The wheel lock angle shall meet one of the following conditions:

- There shall be stoppers to ensure that the wheels cannot be steered to a value higher than the specified value.
- When the wheels are turned to the wheel lock angle, the smallest clearance between the tyre and the nearest point of interference is not less than 15 mm.
- In case of vehicles operating with manual steering system, when the wheels are turned to the wheel lock angle, a margin of quarter turn of steering wheel is left before the maximum travel of steering gear is reached (see Note).
- In case of vehicles operating with hydraulic power steering system, when the wheels are

turned to the wheel lock angle, a margin of 2° on the output shaft side is left before the maximum travel of steering gear is reached (*see* Note).

- e) In case of vehicles in which the rear driven axle is also steerable, the rear wheel geometry is to be aligned and measured before the front

wheel geometry. This does not apply to self-steered axle.

NOTE — The margin of steering wheel turn available after the vehicle wheels are turned to the wheel lock angle, should be checked in vehicle jacked-up condition by applying a force of 100 N [applicable for 5.2 (a) and 5.2 (c)].

Bureau of Indian Standards

BIS is a statutory institution established under the *Bureau of Indian Standards Act, 1986* to promote harmonious development of the activities of standardization, marking and quality certification of goods and attending to connected matters in the country.

Copyright

BIS has the copyright of all its publications. No part of these publications may be reproduced in any form without the prior permission in writing of BIS. This does not preclude the free use, in course of implementing the standard, of necessary details, such as symbols and sizes, type or grade designations. Enquiries relating to copyright be addressed to the Director (Publications), BIS.

Review of Indian Standards

Amendments are issued to standards as the need arises on the basis of comments. Standards are also reviewed periodically; a standard along with amendments is reaffirmed when such review indicates that no changes are needed; if the review indicates that changes are needed, it is taken up for revision. Users of Indian Standards should ascertain that they are in possession of the latest amendments or edition by referring to the latest issue of 'BIS Catalogue' and 'Standards: Monthly Additions'.

This Indian Standard has been developed from Doc No.: TED 04 (1048).

Amendments Issued Since Publication

Amendment No.	Date of Issue	Text Affected

BUREAU OF INDIAN STANDARDS

Headquarters:

Manak Bhavan, 9 Bahadur Shah Zafar Marg, New Delhi 110002

Telephones: 2323 0131, 2323 3375, 2323 9402

Website: www.bis.gov.in

Regional Offices:

Telephones

Central	: Manak Bhavan, 9 Bahadur Shah Zafar Marg NEW DELHI 110002	{ 2323 7617 2323 3841
Eastern	: 1/14, C.I.T. Scheme VII M, V.I.P. Road, Kankurgachi KOLKATA 700054	{ 2337 8499, 2337 8561 2337 8626, 2337 9120
Northern	: Plot No. 4-A, Sector 27-B, Madhya Marg, CHANDIGARH 160019	{ 26 50206 265 0290
Southern	: C.I.T. Campus, IV Cross Road, CHENNAI 600113	{ 2254 1216, 2254 1442 2254 2519, 2254 2315
Western	: Manakalaya, E9 MIDC, Marol, Andheri (East) MUMBAI 400093	{ 2832 9295, 2832 7858 2832 7891, 2832 7892

Branches : AHMEDABAD. BENGALURU. BHOPAL. BHUBANESWAR. COIMBATORE.
DEHRADUN. DURGAPUR. FARIDABAD. GHAZIABAD. GUWAHATI.
HYDERABAD. JAIPUR. JAMMU. JAMSHEDPUR. KOCHI. LUCKNOW. NAGPUR.
PARWANOO. PATNA. PUNE. RAIPUR. RAJKOT. VISAKHAPATNAM.